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Application for Patent

אני, (שם המבקש, מענו – ולגבי גוף מאוגד – מקום התאגדותו)
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(בעברית) (Hebrew) אובטורטור של טרוקר עם אמצעי בטיחותי

(באנגלית) (English) SAFETY TROCAR OBTURATOR

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SAFETY TROCAR OBTURATOR

אובטורטור של טרוקר עם אמצעי בטיחותי

SAFETY TROCAR OBTURATOR

BACKGROUND

Field of the Invention

The present invention relates to a safety trocar device for providing access into patient's body cavity during a minimal invasive surgical procedure.

Prior Art of the Invention

The general trend of the modern trocar development is the use of the safety means preventing the patient's internal organs from injury by a trocar sharp tip. As a rule safety means substantially complicates the trocar design. This in full measure relates to the trocar versions with detachable distal components.

Patent US 5697947 discloses Trocar Obturator Including a Removable Knife, wherein the removable knife is connected to an obturator shaft by a connector including a bulbous knife protrusion, fitting and nut. The trocar is provided with a safety means in the form of a protective sleeve shielding the knife, extending through a trocar cannula and biased distally by two springs disposed at the trocar proximal portion. After use, the trocar assembly should be disassembled, cleaned, sterilized and reused. The disadvantage of the trocar is complexity of its design including about 17 separate details only in the obturator and safety means subassemblies. This substantially hampers the performance of the trocar disassembly, cleaning and subsequent assembly, needed for its reuse. Another disadvantage is relatively high cost of the trocar. Another disadvantage is the danger of the introducing and jamming the tissue fibers in the gaps between the knife and protective sleeve during penetrating the patient's body wall resulting in disturbing the normal operation of the knife and safety means. Another disadvantage is the large resistance to protective sleeve advance through a patient's body cavity wall because of its large diameter resulting in the delay of the knife protection and lowering the safety means effectiveness.

Patent US 5709671 discloses Trocar Having an Improved Tip Configuration, wherein there is a flat knife with a linear cutting edge including a penetrating apex and lateral beveled cutting edges. The knife is surrounded with a movable safety shield, which also fulfils a function of a dilator enlarging the opening in a body cavity wall to adapt it for subsequent cannula insertion. The shield biasing means is located beyond the obturator

distal tip. The disadvantage of the trocar is the complexity of its obturator including two mutually movable shafts independently connecting the knife and the shield with the obturator handle. Another disadvantage is the impossibility of replacing the obturator distal tip without the replacement of the all obturator including its shafts and handle. These both disadvantages predetermine the increased cost of the trocar. Another disadvantage is the large resistance to safety shield advance into the body wall opening, resulting in the delay of the knife protection and lowering the safety means effectiveness. This large resistance arises as a result of using the safety shield as a dilator, as well as because of the shield disposal on all sides of the knife. Another disadvantage is the danger of the introducing and jamming the tissue fibers in the gap between the knife and safety shield during penetrating the patient's body wall resulting in disturbing the normal operation of the knife and safety means. This gap is formed on the knife lateral side opposite to the disposition of its sharpened cutting edge.

SUMMARY OF THE INVENTION

The objective of the present invention is enhancing the effectiveness of the safety means operation due to reducing the resistance to the shield advance into the body tissue.
Another objective is preventing the patient's body tissue from introducing and jamming between the elements of the obturator distal end, specifically between the penetrating apex and safety means, and thereby heightening the reliability of the trocar operation.
Another objective is simplifying the processes of the reusable trocar obturator disassembly, cleaning, sterilizing and subsequent assembly.
Another objective is improving the safety of the reusable trocar obturator disassembly and assembly.
Another objective is improving the manufacturing properties of the trocar obturator, including the minimization of its detail number, simplification of the detail design and obturator assembling, and the unification of the safety means, eventually resulting in the reduction of the manufacturing cost.
The above noted objectives are accomplished with a trocar obturator including: a shaft, an obturator handle disposed on the proximal end of the shaft, and a penetrator disposed on the distal end of the shaft. The penetrator comprises: a dilating sloping surface and consisting of a penetrator base part inseparably connected to the shaft and a penetrator covering part quickly detachable from the penetrator base part; an apex knife adapted to carrying out an incision in a body cavity wall and made as an apex base in the form of a metal plate with a sharpened cutting edge at its distal end detachably housed in the

penetrator, therewith the dilating sloping surface is immovable relative to the shaft during the trocar operation; a safety means for protecting at least the apex knife. The safety means is completely disposed at the penetrator, has at least an apex knife shield designed for the protection of the apex knife, and comprises a biasing spring. The apex knife shield has the width equal to the width of the apex knife and less than maximal diameter of the penetrator, and moreover, the apex knife shield width more than twice exceeds its thickness. The apex knife shield is movably located in shield guides formed by the walls of said penetrator and said apex knife, and adapted to actuating between a retracted position, in which the apex knife is open, and an extended position, in which the apex knife is closed and protected by the apex knife shield. The all elements of said penetrator protruding distally beyond the trocar cannula, including the dilating sloping surface, apex knife and apex knife shield, are made without substantial gaps between them in the all position of the penetrator, thereby preventing the tissue fibers from introducing, jamming or engagement between them during the all stages of penetrating a patient's body cavity wall. Specifically, the apex knife shield is disposed from that side of the apex knife, from which the sharpened cutting edge of the apex knife is disposed, thereby eliminating a gap between the sharpened cutting edge and the apex knife shield and preventing the tissue fibers of the patient's cavity wall from introducing, jamming or engagement between the apex knife shield and the apex knife. This heightens the reliability of the trocar operation. The indicated width, thickness and disposition of the apex knife shield provide the low resistance to the shield advance into the body tissue, enhancing the effectiveness of the safety means operation. The biasing spring is designed for permitting the movement of the apex knife shield towards the retracted position in response to a proximally directed force applied to the apex knife shield distal edge during penetrating the patient's body cavity wall, and for biasing the apex knife shield towards the extended position when the force applied to the apex knife shield distal edge is removed while the apex knife shield enters the patient's body cavity, however before the penetrator has been fully inserted into the patient's body cavity. The safety means is made as a unified universal means with the width of the apex knife shield less than 5 mm suitable for 5 mm penetrator maximal diameter and therefore applicable for the penetrators having the greater diameters. The performance of the safety means as a unified means along with the minimizing the safety means details due to their complete disposal at the penetrator allow substantial reducing the trocar obturator cost and improving its manufacturing properties.

The trocar obturator is provided with a quickly acting connecting means allowing quick attachment / detachment of the safety means and apex knife to / from the penetrator, as well as the penetrator covering part to / from the penetrator base part.

Moreover, there is an auxiliary guide means designed for more convenient, simple and precise putting together the constituents of the penetrator until they have been completely attached by the quickly acting connecting means. The quickly acting connecting means and the auxiliary guide means provide the simplification and acceleration of the process of the reusable trocar disassembly and subsequent assembly, as well as the improvement of the convenience of this process performance. The apex knife shield, apex base and biasing spring are capable of being put together as a separate penetrating subassembly suitable for the replacement as a single unit. Using this single unit allows additional enhancing the convenience and speed of the trocar obturator assembly and disassembly. Specifically, the indicated single unit creates the favorable conditions for cost-effective application of the present trocar obturator in a partly reusable version, wherein only this single unit is a disposable component.

In version embodiment, the penetrator is provided with lateral knives, which along with the apex base are made as a single member, and these lateral knives protrude from the dilating sloping surface through a slot in the penetrator. The lateral knives facilitate the advance of the penetrator into the body tissue. At the same time, their fabrication as the elements of the apex base maintains the all above advantages of the trocar obturator including its low cost, the easy replacement of its safety means and knives, and high reliability. There are also lateral shields designed for protecting the lateral knives. The lateral shields along with the apex knife shield are made as a single shield member. In the penetrating subassembly lying outside the trocar obturator, the shield member is in a preset position and the lateral knives are protected with the lateral shields. This allows safe attaching / detaching the penetrating subassembly to / from the penetrator of the reusable trocar obturator. During attaching the penetrating subassembly to the trocar obturator, the shield member is transposed from the preset position to the extended position, wherein the lateral knives are not protected and ready for tissue cutting.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1 to 19 show the trocar obturator with detachable cutting means and safety means designed for protecting only a penetrating apex.

Fig. 1 shows the general side view of the trocar obturator with detachable flat apex base and flat shield.

Fig. 2 shows the close-up general side view of the trocar obturator penetrating assembly.

Fig. 3 shows the longitudinal section of the trocar obturator penetrating assembly.

Fig. 4 shows the side view of the penetrating assembly with the dilator base part.

Figs. 5 shows the top view of the penetrating assembly with the dilator base part.

Fig. 6 shows the longitudinal section of the penetrating assembly with the dilator base part.

Figs. 7, 8 show the cross sections of the dilator base part.

Fig. 9 shows the side view of the dilator covering part.

Fig. 10 shows the bottom view of the dilator covering part.

Fig. 11 shows the longitudinal section of the dilator covering part.

Figs. 12, 13, 14 show the cross sections of the dilator covering part.

Fig. 15 shows the longitudinal section of the clamping nut fixing the constituents of the penetrating assembly.

Figs. 16 shows the top view of the separate subassembly including the apex base, the shield and the biasing spring.

Figs. 17 shows the side view of the separate subassembly including the apex base, the shield and the biasing spring.

Fig. 18 shows the bottom view of the separate subassembly including the apex base, the shield and the biasing spring.

Fig. 19 shows the top view of the penetrating assembly with the clamping nut in unclamped state.

Figs. 20 to 25 show the trocar obturator with detachable cutting means and safety means designed for protecting a penetrating apex and lateral knives.

Figs. 20 shows the side view of the separate subassembly including the apex base, the shield and the biasing spring.

Fig. 21 shows the bottom view of the separate subassembly including the apex base, the shield and the biasing spring.

Figs. 22 shows the top view of the separate subassembly including the apex base, the shield and the biasing spring.

Fig. 23 shows the longitudinal section of the trocar obturator penetrating assembly with the clamping nut in unclamped position.

Fig. 24 shows the longitudinal section of the trocar obturator penetrating assembly in the early stage of screwing the clamping nut onto the dilator.

Fig. 25 shows the longitudinal section of the trocar obturator penetrating assembly in the closing stage of screwing the clamping nut onto the dilator.

DETAILED DESCRIPTION OF THE INVENTION

The description of the present invention is offered with references made to the attached drawings.

Trocar obturator 30, shown in fig. 1, adapted to removable inserting into a cannula (not shown) and subsequent forming a passageway in a patient's body cavity wall, includes: shaft 31, obturator handle 32 disposed on the proximal end of shaft 31, and penetrating assembly 33 disposed on the distal end of shaft 31 and partly protruding distally beyond the distal end of the cannula. Penetrating assembly 33 (figs. 2, 3) comprises: penetrator 34 having dilating sloping surface 35 of conical form; apex knife with sharpened cutting edge 36 adapted to carrying out an incision in the body cavity wall, located on apex base 37 made as a flat plate and detachably housed in penetrator 34, therewith apex knife 36 and dilating sloping surface 35 are immovable in the shaft axial direction relative to shaft 31 during the trocar operation; a safety means for protecting at least apex knife 36. Penetrator consists of penetrator base part 38 (figs. 4 to 8) inseparably connected to shaft 31 and penetrator covering part 39 (figs. 9 to 14) quickly detachable from penetrator base part 38. Trocar obturator 30 is provided with two lateral knives 40, 41 protruding from dilating sloping surface 35. Lateral knives 40, 41 and apex base 37 are made as a single detail and the lateral knives protrude from sloping surface 35 through slot 42 formed between penetrator parts 38 and 39. Lateral knives 40, 41 facilitate the advance of penetrator 34 into the body tissue. At the same time, their fabrication as the elements of apex base 37 allows maintaining the all advantages of the trocar obturator including its low cost, the easy replacement of its safety means and knives, and high reliability.

The safety means is completely disposed at penetrator 34 and has flat apex knife shield 43 designed for the protection of apex knife 36 and adapted to actuating between a retracted position (not shown), in which apex knife 36 is open, and an extended position (figs. 1 to 3), in which apex knife 36 is closed and protected by apex knife shield 43. Shield 43 is movably located in shield guides formed by the walls of apex base 36 and longitudinal guide groove 44 made in a distal portion of penetrator base part 38 on its surface faced penetrator covering part 39. Therewith, there are no substantial gaps between shield 43 and the walls of guide groove 44. Shield 43 is disposed from that side of apex knife 36, from which the sharpened cutting edge of apex knife 36 is disposed, thereby eliminating a gap between the sharpened cutting edge of apex knife 36 and shield 43 and preventing the tissue fibers of the patient's cavity wall from introducing, jamming or engagement between shield 43 and apex base 37. As a whole, the all

elements of penetrating assembly 33 protruding distally beyond the trocar cannula, including dilating sloping surface 35, apex knife 36 and apex knife shield 43, are made without substantial gaps between them in the all position, thereby preventing the tissue fibers from introducing, jamming or engagement between them during the all stages of penetrating a patient's body cavity wall. This heightens the reliability of the trocar operation. Apex knife shield 43 has the width equal to the width of apex knife 36 and less than maximal diameter of penetrator 34, and moreover, the apex knife shield width more than twice exceeds its thickness. The performance of shield 43 as a flat plate having a small cross-sectional area due to its indicated width and thickness, as well as its indicated disposition from one side of apex knife 36 provide the low resistance to the shield advance into the body tissue, enhancing the effectiveness of the safety means operation. Projection 45 of shield 43 is adapted to abutting against ledge 46 in penetrator covering part 39 eliminating the displacement of shield 43 distally of its extended position. The safety means also comprises biasing spring 47 for permitting the movement of shield 43 towards the retracted position in response to a proximally directed force applied to shield distal edge 48 during penetrating the patient's body cavity wall, and for biasing shield 43 towards the extended position, when the force applied to shield distal edge 48 is removed while shield 43 enters the patient's body cavity, however before dilating sloping surface 35 has been fully inserted into the patient's body cavity. Biasing spring 47 is located between penetrator parts 38, 39 in longitudinal recess 49 made partly in penetrator base part 38 and partly in penetrator covering part 39.

In version embodiment, the safety means is made as an unified universal means with the width of shield 43 less than 5 mm suitable for 5 mm maximal diameter of penetrator 34 and therefore applicable for the penetrators of greater diameters. The performance of the safety means as an unified means along with the minimizing the safety means details 43, 47 due to their complete disposal at penetrator 34 allow substantial reducing the trocar obturator cost and improving its manufacturing properties.

In another version embodiment (not shown), there is an additional shield located from another side of the apex knife, therewith both shields have a common base and are biased by a common biasing spring.

In another version embodiment (not shown), the shield and the biasing spring are made as a single detail.

In another version embodiment (not shown), the apex knife, apex knife shield and biasing spring are made as a single detail.

Trocar obturator 30 is provided with a quickly acting connecting means allowing quick attachment / detachment of the safety means including its shield 43 and biasing spring 47

as well as apex base 37 to / from penetrator 34. The quickly acting connecting means includes a thread clamping nut 50, a connecting thread 51 located on a proximal portion of penetrator base part 38, and proximal shank 52 of penetrator covering part 39 adapted to clamping by thread clamping nut 50.

Shield 43, apex base 37 and biasing spring 47 are capable of being put together as separate penetrating subassembly 53 (figs.16 to 19) suitable for the replacement as a single unit.

Penetrating assembly 33 includes an auxiliary guide means designed for more convenient, simple and precise putting together the constituents of the penetrating assembly until they have been completely attached by the quickly acting connecting means. The auxiliary guide means include guide pin 54 located on penetrator base part 38 and designed for entering guide opening 55 in apex base 37 and guide opening 56 in penetrator covering part 39, as well as lateral protrusions 57, 58 on penetrator base part 38 designed for lateral guidance penetrating subassembly 53 and for entering notches 60, 59, on penetratorator covering part 39. The quickly acting connecting means and the auxiliary guide means facilitate the trocar obturator assembling, lowering its manufacturing cost. Moreover, they provide the simplification and acceleration of the reusable trocar disassembly and subsequent assembly, as well as the improvement of the operation convenience. Using single unit 53 allows additional enhancing the convenience and speed of the trocar obturator assembly and disassembly. Specifically, single unit 53 creates the favorable conditions for cost-effective application of trocar obturator 30 in a partly reusable version, wherein only single unit 53 is a disposable component.

In version embodiment, shown in figs. 20 to 25, penetrating assembly 133 includes separate penetrating subassembly 153 comprising apex base 137 with apex knife 136 and two dilating lateral knives 140, 141, as well as shield member 143 with lateral shields 164, 165, whose outer edges are equidistant to lateral knives 140, 141, respectively. There is also biasing spring 147, mounted between apex base 137 and shield member 143. In penetrating subassembly 153 lying outside penetrating assembly 133 (figs. 20 to 22), shield member 143 is in the preset position, wherein it protects apex knife 136 by shield distal protrusion 166, as well as lateral knives 140, 141 by lateral shields 164, 165, respectively (fig.22). During mounting penetrating subassembly 153 into penetrating assembly 133 (figs. 23 to 25), apex base 137 along with penetrator covering part 139 is displaced distally relative to shield member 143 by clamping nut 150. In doing so, clamping nut 150 transmits distally directed axial movement to apex base 137 through penetrator covering part 139 and transmitting element 162 of apex base 137,

compressing biasing spring 147, while shield member 143 is immovable due to restricting element 161 of shield 143. Restricting element 161 and transmitting element 162 relate to the installing means allowing to set shield member 143 into its extended position relative to apex base 137 as a result of screwing clamping nut 150 on penetrator base part 138. In the shield member extended position (fig. 25), lateral knives 140, 141 are not protected with shield member 143, while penetrating apex 136 remains protected with distal protrusion 166 of shield member 143. Henceforward, in the assembled state of penetrating assembly 133, lateral knives 140, 141 are constantly not protected, and shield distal protrusion 166 operates identically to shield 43 of previous penetrating assembly 33, protecting or releasing apex knife 136. After surgery performance, disassembling penetrating assembly 133 and withdrawing penetrating subassembly 153, shield member 143 returns in its preset position, shown in fig. 22, providing the personnel protection from any contact with sharp edges of apex base 137. Penetrating assembly 133 has an auxiliary guide means designed for more convenient, simple and precise putting together the penetrator parts 138, 139 and penetrating subassembly 153 until they have been completely attached by the quickly acting connecting means. The auxiliary guide means include recess 163 in penetrator base part 138, wherein transmitting element 162 is movably housed, as well as the lateral protrusions on penetrator base part 138 (not shown) identical to lateral protrusions 57, 58 (figs. 5, 7, 19) for lateral guidance of penetrating subassembly 153. The version embodiments, shown in figs. 1 to 19 and figs. 20 to 25, comprise many identical details having the same two last numerals in their designations. The description of these details, made for figs. 1 to 19, can be also used for the details of figs. 20 to 25, if they have not their own description.

Claims:

1. A trocar obturator adapted to removable inserting into a cannula and subsequent forming a passageway in a patient's body cavity wall, including

- A shaft,
- An obturator handle disposed on the proximal end of said shaft,
- A penetrator disposed on the distal end of said shaft and comprising
- a dilating sloping surface protruding distally beyond the distal end of said cannula and immovable in the shaft axial direction relative to said shaft during the trocar operation,
- an apex knife with a sharpened cutting edge protruding distally beyond the distal end of said dilating sloping surface, adapted to carrying out an incision in a body cavity wall, and having the width which is less than maximal diameter of said penetrator,
- a safety means for protecting said apex knife,
- Said safety means comprising:
- an apex knife shield designed for the protection of said apex knife, having the width substantially equal to the width of said apex knife, movably located in shield guides and adapted to actuating between a retracted position, in which said apex knife is open, and an extended position, in which said apex knife is closed and protected by said apex knife shield, therewith said shield guides are formed by the walls of said penetrator and said apex knife, and said apex knife shield is disposed from that side of said apex knife, from which said sharpened cutting edge is disposed, thereby eliminating a gap between said sharpened cutting edge and said apex knife shield and preventing the tissue fibers from introducing, jamming or engagement between said apex knife shield and said apex knife;
- and a biasing spring for permitting the movement of said apex shield towards said retracted position in response to a proximally directed force applied to said apex shield distal edge during penetrating a patient's body cavity wall, and for biasing said apex shield towards said extended position when the force applied to said apex shield distal edge is removed while said shield enters a patient's body cavity, however before said dilating sloping surface has been fully inserted into the patient's body cavity.

2. The trocar obturator of claim 1, wherein said apex knife has an apex base made of a metal plate, said sharpened cutting edge is disposed on the distal end of said apex base, and one of the walls of said shield guides is formed with said apex base.

3. The trocar obturator of claim 2, wherein said apex knife shield, apex base and biasing spring form a separate penetrating subassembly adapted for mounting into said penetrator.

4. The trocar obturator of claim 3, having quickly acting connecting means allowing quick attachment / detachment of said penetrating subassembly to / from said shaft.

5. The trocar obturator of claim 1, wherein said dilating sloping surface has a conical form.

6. The trocar obturator of claim 4, wherein said penetrator consists of a penetrator base part inseparably connected to said shaft and a penetrator covering part quickly detachable from said penetrator base part.

7. The trocar obturator of claim 6, wherein said penetrator includes an auxiliary guide means designed for more convenient, simple and precise putting together the constituents of said penetrator until they have been completely attached by said quickly acting connecting means.

8. The trocar obturator of claim 7, having: said auxiliary guide means including a guide pin located on one of said penetrator parts and correspondent to guide openings of said apex base and the another penetrator part for precise and quick putting together said apex base and said penetrator parts; a longitudinal recess made in at least one of said penetrator parts for the location of said biasing spring between said penetrator parts; a longitudinal guide groove designed for guiding said apex knife shield and made in a distal portion of at least one of said penetrator parts on its surface faced another said penetrator part; a restricting means eliminating the displacement of said apex knife shield distally of its said extended position; said quickly acting connecting means including a thread clamping nut, a connecting thread located on a proximal portion of said penetrator base part and a proximal shank of said penetrator covering part adapted to clamping by said thread clamping nut.

9. The trocar obturator of claim 1, wherein said width of apex knife shield exceeds its thickness.

10. The trocar obturator of claim 9, wherein said width of apex shield more than twice exceeds its said thickness.

11. The trocar obturator of claim 1, wherein there is an additional apex knife shield located from the opposite side of said apex knife with respect to said apex knife shield, therewith both said shields have a common base and are biased by common said biasing spring.

12. The trocar obturator of claim 2, wherein there is at least one lateral knife protruding from said dilating sloping surface.

13. The trocar obturator of claim 12, wherein there are two said lateral knifes.

14. The trocar obturator of claims 13, wherein said lateral knifes and apex base are made as a single detail and said lateral knifes protrude from said dilator sloping surface through a slot in said dilator.

15. The trocar obturator of claim 1, wherein said apex knife shield and said biasing spring are made as a single detail.

16. The trocar obturator of claim 15, wherein said apex base, apex knife shield and biasing spring are made as a single detail.

17. The trocar obturator of claim 10, wherein said width of apex knife shield does not exceed five mm.

18. The trocar obturator of claim 14, having lateral safety means protecting said lateral knifes.

19. The trocar obturator of claims 3,18, wherein said lateral safety means are designed for the personnel protection during the operations with said penetrating subassembly residing beyond said trocar obturator and include lateral shields which along with said apex knife shield are made as a single shield member, and said shield member is configured so that in a shield member preset position, while said penetrating subassembly is beyond said trocar obturator, said lateral knifes are protected with said lateral shields, and there is an installing means allowing the displacement of said

apex base and said shield member relative to each other during mounting said penetrating subassembly onto said trocar obturator so that, after said penetrating subassembly connection to said trocar obturator, said lateral knifes are not protected, therewith said apex knife is protected both in said shield member preset position and in said shield extended position.

20. The trocar obturator of claims 19, wherein said installing means includes a restricting element preventing said shield member from displacing distally during mounting said penetrating subassembly and a translating element translating the distally directed axial movement of said quickly acting connecting means to said apex base during mounting said penetrating subassembly.

21. A trocar obturator adapted to removable inserting into a cannula and subsequent forming and dilating an incision in a patient's body cavity wall, including:

- A shaft,
- An obturator handle disposed on the proximal end of said shaft,
- A penetrating subassembly disposed at the distal end of said shaft, suitable for the replacement as a single unit and having:
  - an apex knife for forming said incision,
  - and apex safety means,
- Said safety means comprising:
  - an apex knife shield designed for the protection of said apex knife and adapted to actuating between a retracted position, in which said apex knife is open, and an extended position, in which said apex knife is closed and protected by said apex knife shield,
  - and a biasing spring for permitting the movement of said apex knife shield towards said retracted position in response to a proximally directed force applied to said apex knife shield distal edge during penetrating a patient's body cavity wall, and for biasing said apex knife shield towards said extended position when the force applied to said apex knife shield distal edge is removed while said apex knife shield enters a patient's body cavity, however before said penetrating subassembly has been fully inserted into the patient's body cavity,
- A quickly acting connecting means allowing quick attachment / detachment of said penetrating subassembly to / from said shaft.

22. The trocar obturator of claim 21, wherein said penetrating subassembly is placed inside a dilator having a dilating sloping surface immovable in the shaft axial direction relative to said shaft during the trocar operation, and there is at least one lateral knife, therewith said at least one lateral knife and said apex knife are made as a single detail and said at least one lateral knife protrudes from said dilating sloping surface through a slot in said dilator.

23. The trocar obturator of claim 22, wherein there are lateral safety means protecting said at least one lateral knife, designed for the personnel protection during the operations with said penetrating subassembly residing beyond said trocar obturator, and including at least one lateral shield which along with said apex knife shield are made as a single shield member, which is configured so that in a shield member preset position, while said penetrating subassembly is beyond said trocar obturator, said at least one lateral knife is protected with said at least one lateral shield, and there is an installing means allowing the displacement of said apex base and said shield member relative to each other during mounting said penetrating subassembly onto said trocar obturator so that, after said penetrating subassembly connection to said trocar obturator, said at least one lateral knife is not protected, therewith said apex knife is protected both in said shield member preset position and in said extended position.

24. A penetrating subassembly for a trocar obturator disposed at a distal end of said obturator, made as a replaceable single unit, and including:

- an apex knife for forming an incision in a body cavity wall;
- and apex safety means, comprising:
- an apex knife shield designed for the protection of said apex knife and adapted to actuating between a retracted position, in which said apex knife is open, and an extended position, in which said apex knife is closed and protected by said apex knife shield;
- and a biasing spring for permitting the movement of said shield towards said retracted position in response to a proximally directed force applied to said apex knife shield distal edge during penetrating a patient's body cavity wall, and for biasing said apex knife shield towards said extended position when the force applied to said apex knife shield distal edge is removed while said apex knife shield enters a patient's body cavity, however before said penetrating subassembly has been fully inserted into the patient's body cavity;

- a quickly acting connecting means allowing quick attachment / detachment of said penetrating subassembly as a single unit to / from said obturator.

25. The trocar obturator of claim 24, wherein said penetrating subassembly is located inside a dilator having a dilating sloping surface immovable in the shaft axial direction relative to said shaft during the trocar operation, and there is at least one lateral knife, therewith said lateral knife and apex knife are made as a single detail and said at least one lateral knife protrudes from said dilating sloping surface through a slot in said dilator.

26. The trocar obturator of claim 25, wherein there are lateral safety means protecting said at least one lateral knife, designed for the personnel protection during the operations with said penetrating subassembly residing beyond said trocar obturator, and including at least one lateral shield, which along with said apex knife shield are made as a single shield member, which is configured so that in a shield member preset position, while said penetrating subassembly is beyond said trocar obturator, said at least one lateral knife is protected with said at least one lateral shield, and there is an installing means allowing the displacement of said apex base and said shield member relative to each other during mounting said penetrating subassembly onto said trocar obturator so that, after said penetrating subassembly connection to said trocar obturator, said at least one lateral knife is not protected, therewith said apex knife is protected both in said shield member preset position and in said extended position.

27. A trocar obturator adapted to removable inserting into a cannula and subsequent forming a passageway in a patient's body cavity wall, including

- A shaft,
- An obturator handle disposed on the proximal end of said shaft,
- A penetrator disposed on the distal end of said shaft and comprising
  - a dilating sloping surface protruding distally beyond the distal end of said cannula and immovable in the shaft axial direction relative to said shaft during the trocar operation,
  - an apex knife with a sharpened cutting edge protruding distally beyond the distal end of said dilating sloping surface, adapted to carrying out an incision in a body cavity wall,
  - a safety means for protecting said apex knife,

- Said safety means comprising:
  - an apex knife shield designed for the protection of said apex knife, movably located in shield guides and adapted to actuating between a retracted position, in which said apex knife is open, and an extended position, in which said apex knife is closed and protected by said apex knife shield, therewith said shield guides are formed by the walls of said penetrator and said apex knife, and said apex knife shield is disposed between said dilating sloping surface and said apex knife from that side of said apex knife, from which said sharpened cutting edge is disposed, thereby eliminating a gap between said sharpened cutting edge and said apex knife shield and preventing the tissue fibers from introducing, jamming or engagement between said apex knife shield and said apex knife;
  - and a biasing spring for permitting the movement of said apex shield towards said retracted position in response to a proximally directed force applied to said apex shield distal edge during penetrating a patient's body cavity wall, and for biasing said apex shield towards said extended position when the force applied to said apex shield distal edge is removed while said shield enters a patient's body cavity, however before said dilating sloping surface has been fully inserted into the patient's body cavity,
- All elements of said penetrator protruding distally beyond said cannula, including said dilating sloping surface, apex knife and apex knife shield, are made without substantial gaps between them in the all position of said penetrator, thereby preventing the tissue fibers from introducing, jamming or engagement between them during the all stages of penetrating a patient's body cavity wall.

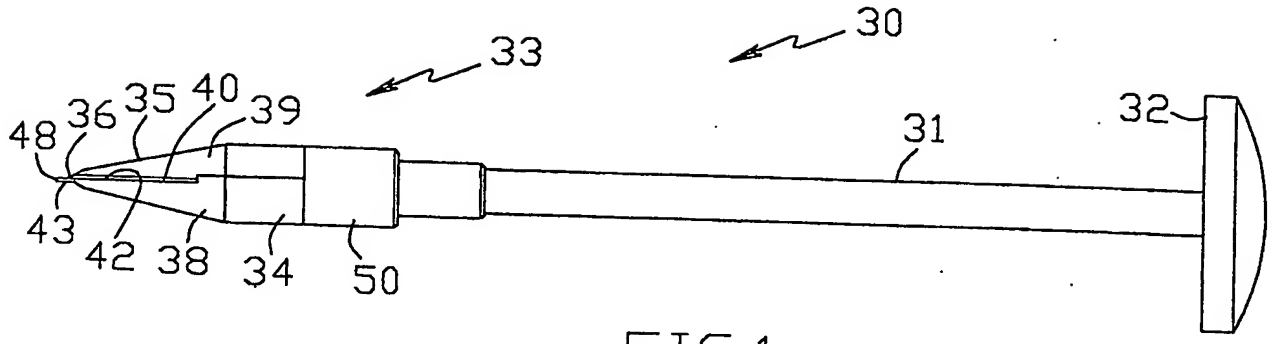


FIG.1

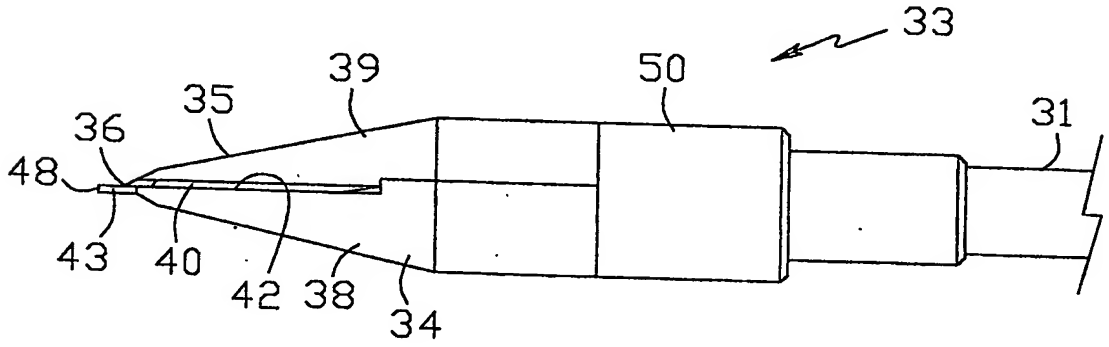


FIG.2

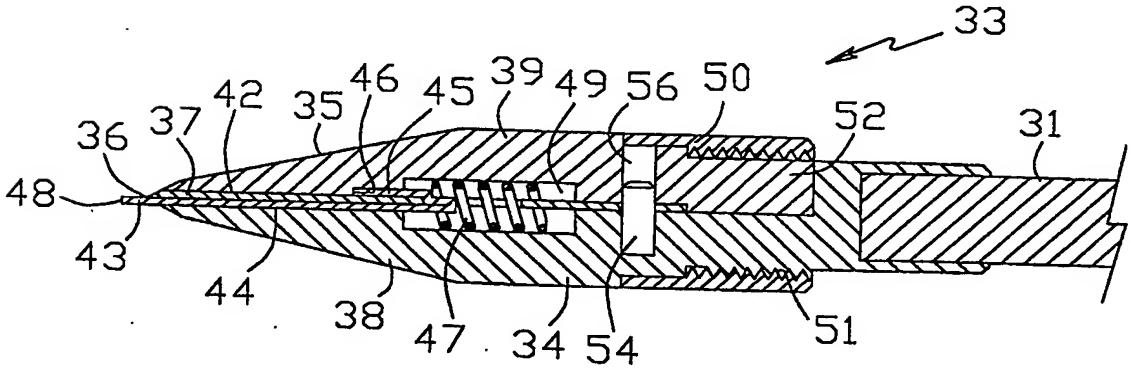


FIG.3

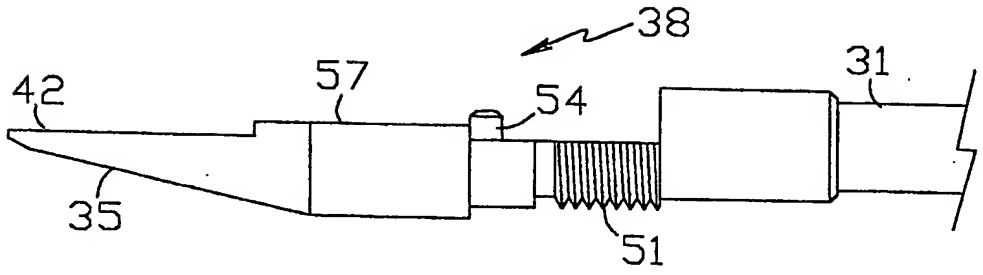


FIG.4

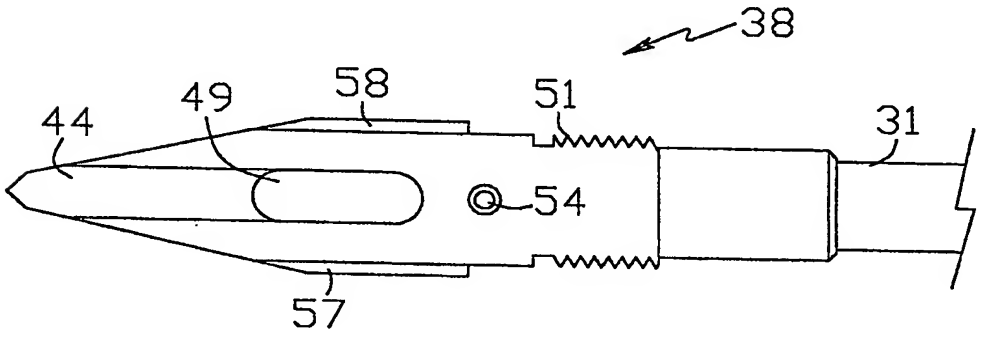


FIG.5

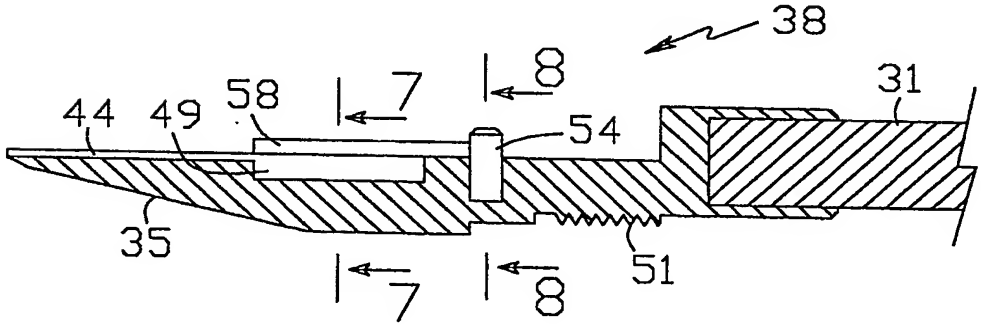
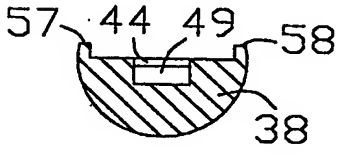


FIG.6



FIC.7

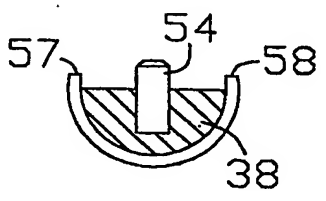


FIG.8

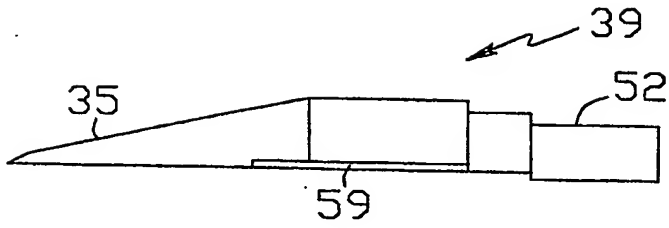


FIG.9

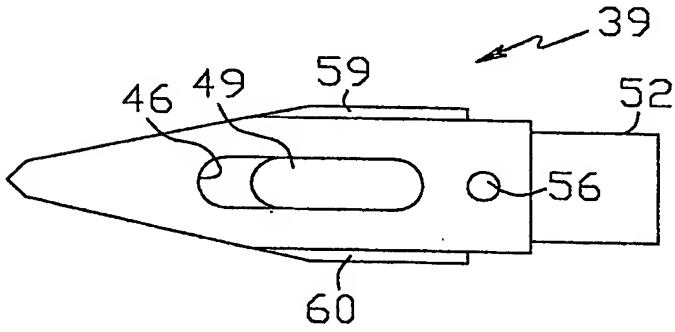


FIG.10

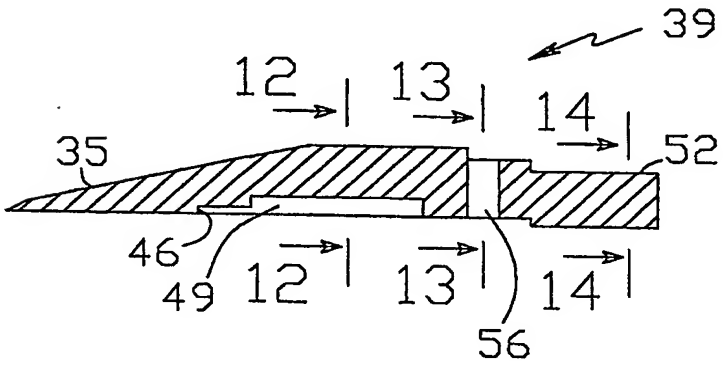


FIG.11

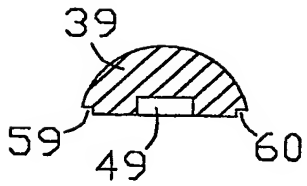


FIG.12

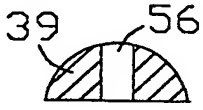


FIG.13

FIG.14

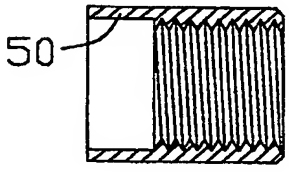


FIG.15

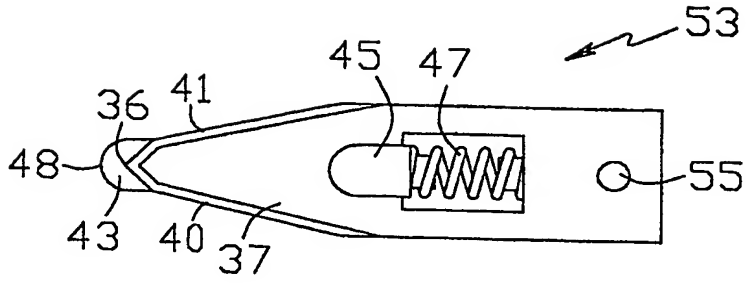


FIG.16

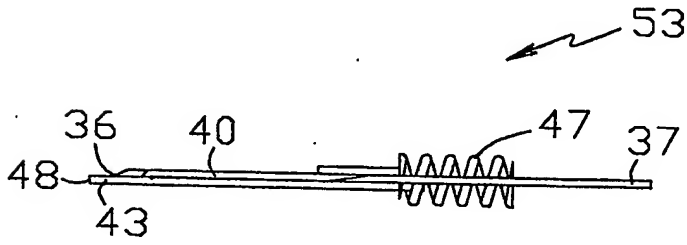


FIG.17

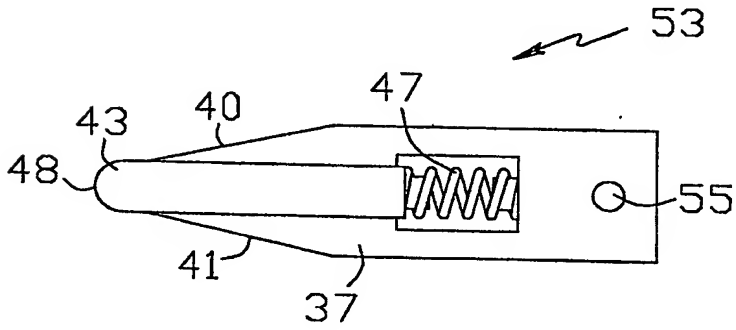


FIG.18

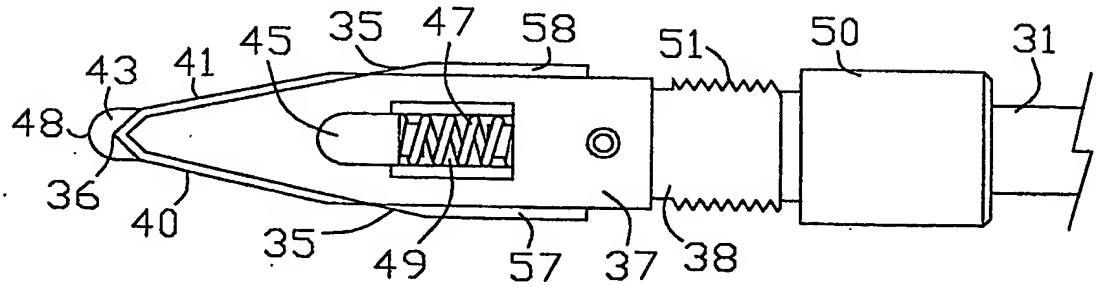


FIG.19

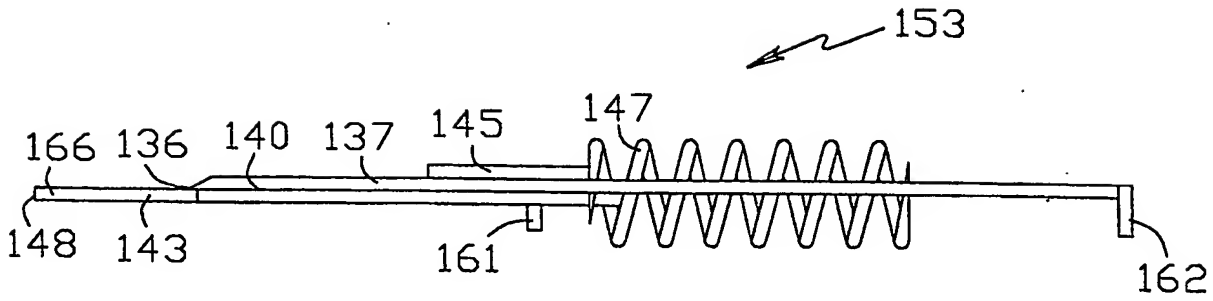


FIG.20

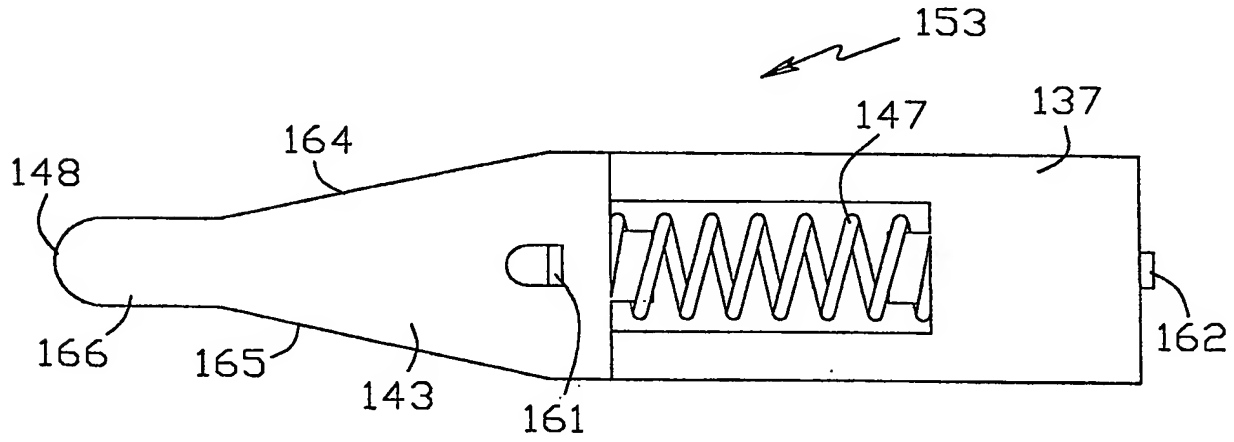


FIG.21

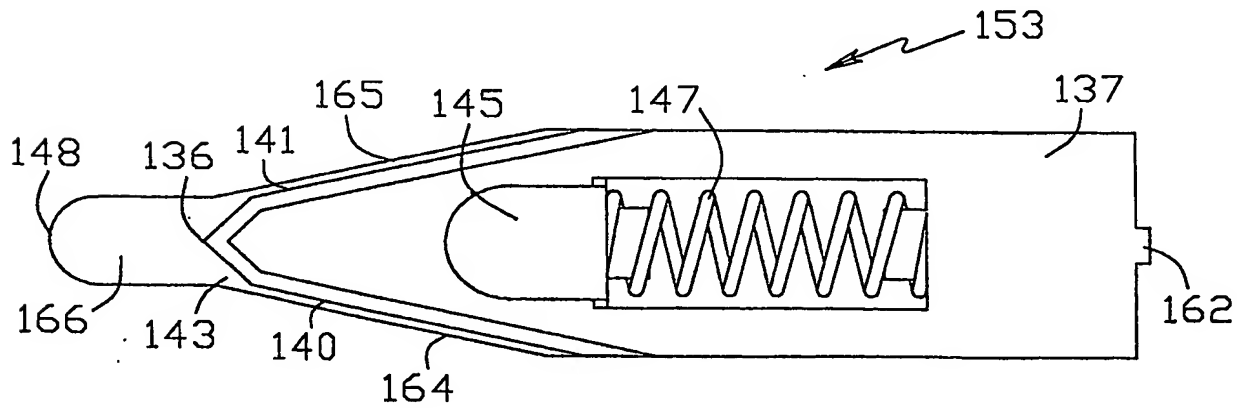


FIG.22

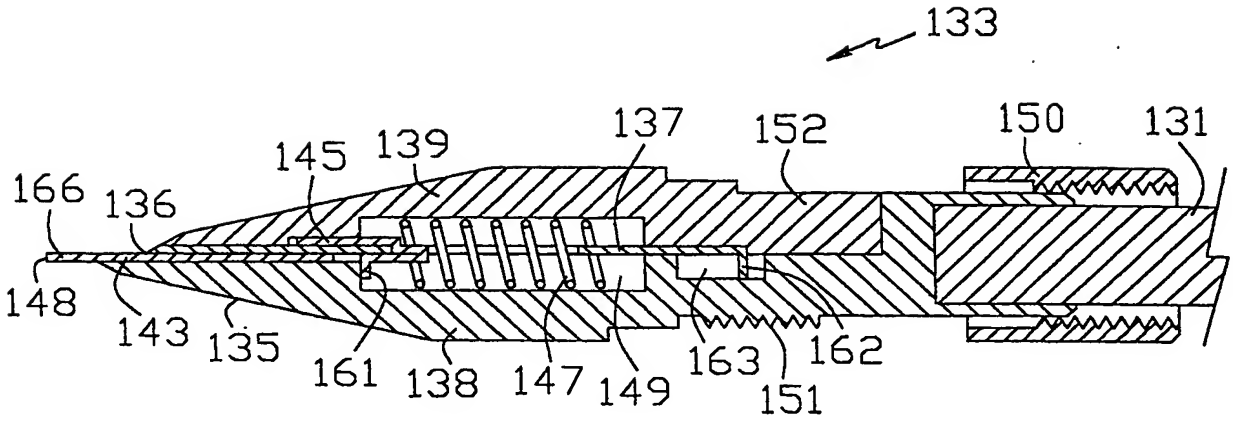


FIG.23

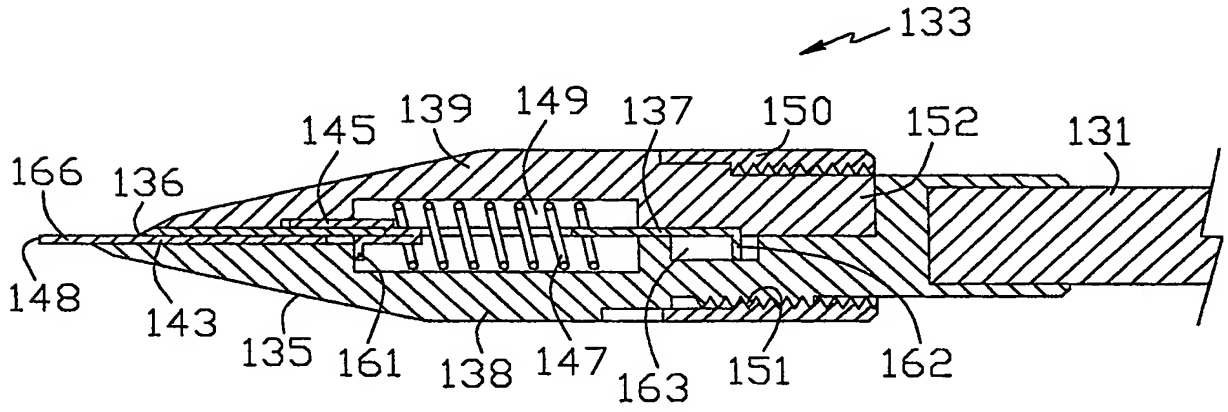


FIG.24

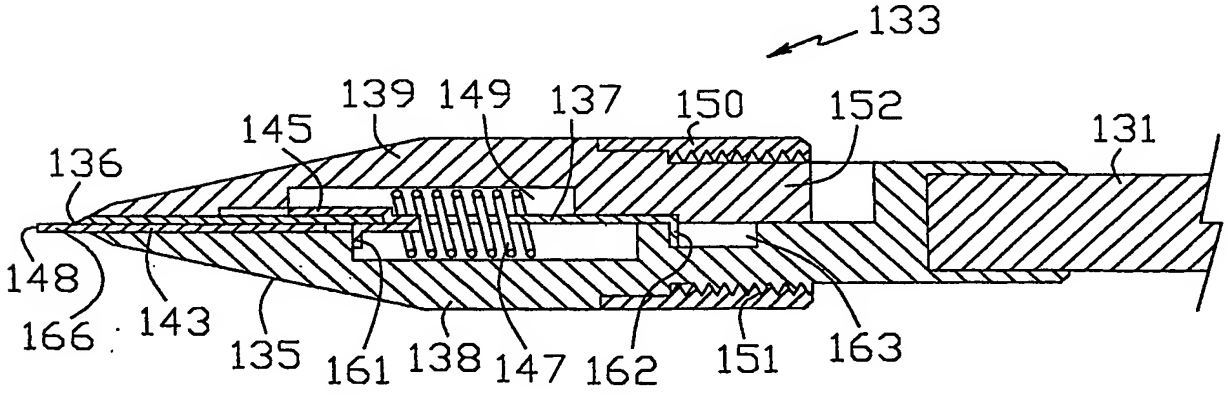


FIG.25